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Progress in Technology Development for an Air-Deployed Sensor System for Rapid, Near-Surface Site Characterization[1]

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Abstract

Holding hard and deeply buried targets (HDBTs) at risk presents an important challenge to the US military. We are researching the key technologies for an aerially deployed sensor system that would help assure the survival of an earth-penetrating weapon in a strike on an underground strategic target through rapid geologic site characterization.

In the system concept, an array of seismic sources and sensors (packaged as sensor darts and penetration probes) is aerially deployed at the site. The penetration probes collect actual penetration data from the site. The sensors form *ad hoc* networks to collect data from the penetrators and seismic sensors and transmit the data to a remote processing site where a penetrability map is rapidly constructed. The map can be used to guide the selection of potential aim points.

Research areas for the project include the survivability of the sensors and sources in earth-penetration events, surficial mapping technology, rapid seismic inversion algorithms, and extrapolation from the linear properties inferred from the seismic data to the nonlinear properties that govern the phenomena of earth penetration. We have developed surface-wave tomography computer programs for the near-surface imaging and tested them with field test data. We have assessed the trade-off between sensor dart density and seismic mapping resolution. We have evaluated the formation of *ad hoc* networks and the collection of seismic data using such networks. We have built and ballistically tested prototypes of the penetration probes and sensor darts that are designed to minimize shock loadings on the electronic components. We have performed both laboratory shock tests and field drop tests for the survivability of critical components such as seismometers and network radios.

Currently we are focusing on prototype development and subsystem-level testing. We are continuing to test the surface-wave algorithms for determining seismic velocity models using field test data. We are investigating seismic detection algorithms to improve our ability to locate regions of relative geologic homogeneity. We are packaging the components as functioning penetration probes and sensor darts for ballistic survivability tests later this year.

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